AUTOMATION AND MECHANIZATION

UDC 666.171:666.127:666.125.016.1

DOSING OF CULLET IN PRODUCTION OF GLASS CONTAINERS

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Translated from Steklo i Keramika, No. 1, pp. 3 – 4, January, 2002.

Certain schemes of dosing the internally generated and imported cullet based on single-component or two-component dosing sets and a proportionate continuous weighing unit are considered.

An important operation in the technological process of feeding a mixture of glass batch and cullet into a glass-melting furnace is dosing of cullet. Contemporary glass-melting technology, in addition to using its domestic cullet generated at different stages of producing glass articles, uses as well secondary (imported) cullet supplied by companies collecting recyclable glass and factories for industrial recycling of sheet glass [1].

The cullet generated in a glass container production has the same chemical composition as the glass melt used for glass containers and does not require additional treatment apart from crushing. The content of domestic cullet in a batch-cullet mixture in glass container production does not exceed 10 – 12%. Imported cullet has a heterogeneous composition and is highly contaminated; however, its use is dictated by the shortage of domestic cullet, a growing demand for disposable glass containers, environmental requirements, and the need for saving energy and material components of the glass batch.

A necessary condition in melting glass using both imported and domestic cullet is the stability of its chemical composition. The existing cullet-dosing schemes as a rule do not provide for preliminary homogenization and proportionate mixing of imported and domestic cullet, which results in temperature and chemical heterogeneity of the glass melt and requires a high homogenizing capacity of the glass-melting furnace.

The single-component and two-component cullet-dosing sets (KDSB and KDSB-2) and a continuous proportioning dosing machine (DNP-20K) produced by Stromizmeritel' JSC are intended for weighing and batching of materials and ensure not only a preset batch-to-cullet ratio [2] but also a preset ratio of imported and domestic cullet.

Several schemes of proportioning imported and domestic cullet are possible. A scheme involving two single-component cullet-dosing sets (Fig. 1) functions in the following way. The domestic cullet and the imported cullet subjected to treatment are transported to the respective service bunkers *1* and *2*, under which the cullet-dosing weighers *3* and *4* are installed. The KDSB dosing set is a batch-type strain-gage discrete scale with charge and discharge vibration feeders. Using a KDSB set, imported and domestic cullet is proportioned to a conveyor belt *5* transporting glass batch from a mixer *6*. The weight of the cullet portions and the output of the discharge feeders of the dosing weighers *3* and *4* in this case is correlated with the weight of the batch portion discharged from the mixer and the duration of its transporting. The cullet weighers, in accordance with a prescribed ratio, maintain the consumption according to a simple dependence:

$$Q_1 = k_1 (Q_2 + Q_3),$$

where Q_1 is the consumption of the batch; Q_2 is the consumption of domestic cullet; $Q_3 = k_2 Q_2$ is the consumption of imported cullet; k_1 and k_2 are the respective coefficients of

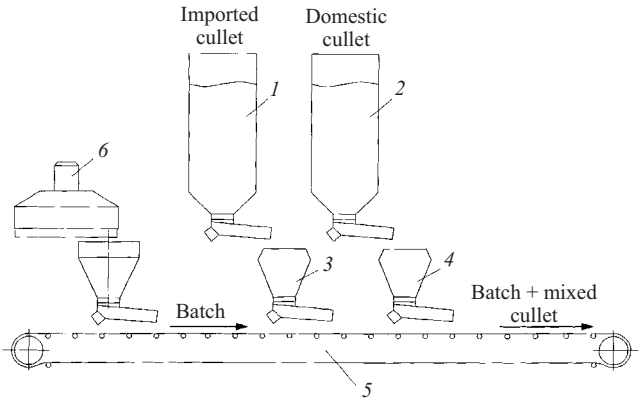

Fig. 1. Cullet dosing scheme using KDSB single-component dosing sets.

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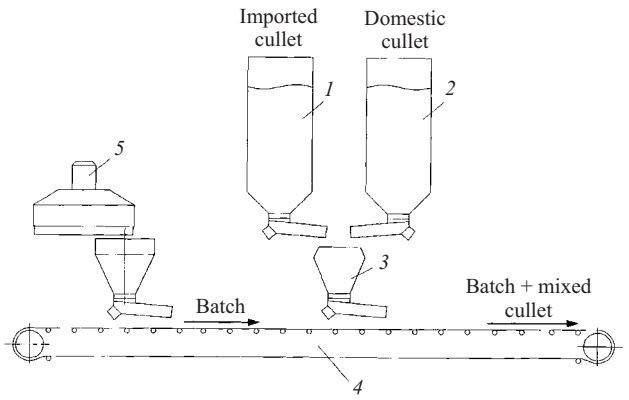

Fig. 2. Cullet dosing scheme using KDSB-2 two-component dosing sets.

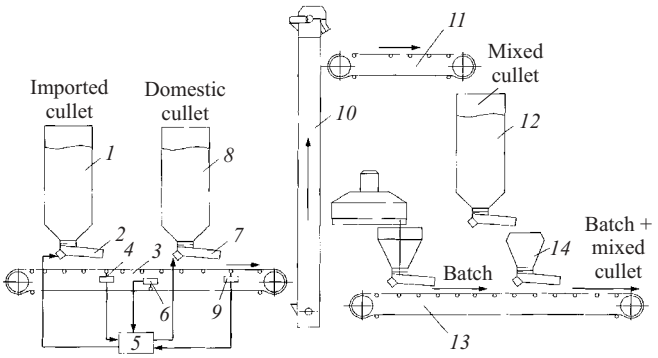

Fig. 3. Cullet dosing scheme using a DNP-20K weigher.

the batch : cullet ratio and the imported cullet : domestic cullet ratio.

Such correlation can be provided as well using a KDSB-2 two-component cullet-dosing set (Fig. 2). The portions of domestic and imported cullet are alternately charged from the service bunkers *1* and *2* to the weigher *3*, and discharge of the batch from a mixer *5* to the conveyor belt *4* intended for batch transportation is implemented similarly to the first variant. The weighing cycle for the cullet portions weighing 300 – 700 kg in both cases lasts 90 – 120 sec, and the error does not exceed 0.5% of the highest dosing limit.

A system of proportioning of cullet using two single-component KDSB sets makes it possible to ensure a more homogeneous feeding of imported and domestic cullet in alternate layers to the batch-transporting conveyor belt, but its overall size is larger and its cost higher than that of a KDSB-2 two-component set. When KDBS and KDSB-2 sets are used as part of a dosing-mixing line to charge the imported and domestic cullet into a mixer, the two-component dosing set is preferred, since the lower cost and the smaller number of equipment items ensure the same quality of mixing of batch with cullet. Therefore, a cullet-dosing system has to be chosen depending on the machinery layout and the requirements imposed on the efficiency, precision, and cost of the equipment.

It is possible to implement proportionate mixing of imported and domestic cullet using a system based on a DNP-20K dosing unit (Fig. 3). The feeder *2* feeds the imported cullet in a uniform flow from an intermediate hopper *1* onto a moving conveyor belt *3*. In transportation, the imported cullet passes above the weight-receiving unit *4*, and the signal from this unit is transmitted to the dosing control system *5*. At the same time, the conveyor belt movement is monitored via a sensor *6*. Depending on the current consumption of the imported cullet and in accordance with a preset imported-to-domestic cullet ratio, computations are performed and a controlling signal is transmitted to the vibration feeder *7*, which discharges the domestic cullet from the hopper *8* onto the layer of imported cullet. Next, the materials are transported above the weight-receiving unit *9*, which transmits a signal corresponding to the total consumption of the materials measured to the control system. Using an elevator *10* and a conveyor belt *11*, the homogenized mixture of the domestic and imported cullet is carried to a service hopper *12* installed on the line for dosed feeding of batch and cullet into a glass-melting furnace. The proportioning and discharge of the mixture of imported and domestic cullet onto the batch-transporting conveyor belt *13* is implemented using a single-component dosing set *14*, which can be replaced by a DNP-20K weigher.

The use of KDSB and KDSB-2 sets and the DNP-20K weigher significantly increases the efficiency of glass-melting with an increased content of imported cullet.

Similar systems for homogenization and proportioning of imported and domestic cullet are being prepared for installation at several factories manufacturing glass containers and can be used at other enterprises in the glass industry.

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